

## CHAPTER 4

### ENGINEERING DISCIPLINE, EMPLOYING INDUSTRY AND THE REGISTRATION OF ENGINEERS

This chapter explores the relationship between employment location and the licensing of engineers and whether employment locations contribute to varying registration rates among the branches of engineering. Since many exemptions from licensing are based on employment location, it is reasonable to expect that the distribution of a state's engineering work force would affect the state's registration rate. If different engineering disciplines are concentrated in particular employment sectors, this would help to explain variations in their registration rates.

Information on employment location comes from the Occupation Employment Statistics (OES) survey, jointly sponsored by the U.S. Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). Prior to 1996, the program produced only national industry-specific estimates of occupational employment, with data collected from selected industries in each year of a three-year cycle. Beginning in 1996, the OES program collected occupational employment data for selected industries in every state, reporting employment data by both occupation and industry. The last three-year cycle covered 1996 through 1998. These three years have been combined to produce the 1998 results. Data has been collected annually for all covered industries beginning in 1999.

Another change in the OES survey affecting the data used in this report also occurred in 1999. In that year, BLS changed the occupational classification system to that used by the Office of Management and Budget (OMB). The Standard Occupational Classification (SOC) system is now used by all federal statistical agencies for reporting occupational data. Although most engineering occupations are the same, the previous OES category of "all other engineers" is no longer published and biomedical and environmental engineers have been added. Two categories in the old system, computer engineering and electrical and electronic engineering, overlapped by each counting computer hardware engineers within their area. In the new system, two categories have become five with computer software, applications and computer software, systems distinguished within the former category of computer engineering and electrical and electronic distinguished within their area. Computer hardware became the fifth category, separated from both. For all tables using 2000 data, electrical, electronic, and computer hardware have been combined into one category. For all tables using 1988-1998 data, the category of computer engineer has been excluded.

While BLS publishes the national data, individual states are responsible for making their state's data available to users. Data was available for all three discipline-based licensing states and four of the generic licensing states (Florida, North Carolina, Pennsylvania and Texas) post their OES data on the web. As a result, these are the only states described in the tables on employment industry.

#### Engineering Discipline

**Proportional distribution of disciplines.** In 2000, the OES survey found that, nationally, persons employed as electrical engineers outnumbered mechanical and civil by 1.7 to 1.<sup>1</sup> This ratio varies widely in California and its comparison states and is noticeably greater in discipline-based than in generic licensing states. Discipline-based states average 2.5 electrical engineers for every mechanical engineer and 2.4 for every civil engineer; comparable ratios in generic

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<sup>1</sup> Electrical engineering includes electrical, electronic (except computer) and computer hardware.

states are 1.6 for both mechanical and civil. Collectively, these three disciplines account for 63.8% of all employed engineers in the nation, with industrial engineering the only other branch with double-digit percentages.

There are more environmental engineers (4.8% vs. 3.5%) and twice the proportion of chemical engineers (3.4% vs. 1.5%) in the generic licensing states than in the discipline-based states. Finally, there is three times the proportion of aerospace engineers in discipline-based than in the generic states, largely due to their concentration in California and, to a lesser extent, in Texas and Florida. (Table 4.1 and 4.2)

There has been a noticeable shift in the proportion of engineers employed in different disciplines between 1988-90 and 2000. The proportion of chemical engineers has declined by almost 50%, mechanical and electrical engineers by 17%, and aeronautical/ aerospace engineers by 15%. Disciplines that have increased include civil (by 19%), industrial (by 23%), mining (by 100%) and safety (by 112%). (Table 4.3)

**Rates per 100,000 population.** A state's licensing type and registration rate may be related to the relative numbers of engineers in the state. The number of employed engineers per 100,000 population was computed for California and the ten comparison states and summarized for the discipline-based and generic licensing states. Discipline-based states have 42% more engineers than generic licensing states (519 vs. 365 per 100,000). Discipline-based states have almost twice as many electrical engineers (197 vs. 106 per 100,000 in generic states) and 25% to 30% more mechanical and industrial engineers (87 vs. 69 and 72 vs. 55 respectively), but similar rates for civil (68 vs. 65). However, the number of civil engineers per 100,000 is higher in California (84) than in any of the comparison states (a range of 42 to 78). The newer and more specialized branches of engineering are more common in the discipline-based states. There are roughly twice as many aerospace and biomedical engineers (21 vs. 9.8 and 4.7 vs. 1.75 per 100,000 respectively), and roughly 50% more environmental and health and safety engineers (26.3 vs. 18.1 and 14 vs. 9.5) as in the generic states. Marine and mining engineering are specialties found more often in the generic states, but in small numbers. (Table 4.4 and 4.5)

## Employing Industry

Engineers in the three disciplined-based licensing states have very different industry profiles. The proportion employed in engineering and architectural services in Massachusetts is double that in California (25.1 vs. 12.1%) and three times the proportion in Rhode Island (8.6%). On the other hand, Rhode Island's engineers are mostly in government employment (60%) while almost three-fourths of employed engineers in Massachusetts and California work for corporations (72% each). The generic states are diverse as well. Pennsylvania is similar to Massachusetts in the proportion in engineering and architectural services (29%), but more like California and Florida in having a moderate amount of government employment (13.7 vs. 15.7% and 14.4%). It therefore has fewer engineers in corporate employment than the other generic states for which employment data are available (57% vs. 71 to 84%). (Table 4.6)

In 2000, engineers as a whole were primarily employed by industrial corporations (69%), with 20% in engineering and architectural services and 11% in government employment. In contrast to the other disciplines, civil engineers were much more apt to be employed in engineering and architectural services than in government or private industry (50.6% vs. 29.4% and 20% respectively). Agricultural engineers had the second highest proportion in consulting services (22.1%) and the second fewest in corporate employment (56.9%). Most engineers in the other disciplines are employed by corporations (between 72% and 95%). In addition, only civil,

agricultural and nuclear engineers are employed by government in any significant numbers (29.4%, 21% and 15.8% respectively). (Table 4.7)

This represents a shift over the preceding decade of agricultural engineers *into* government employment and of civil engineers *out* of it. There was little change for either discipline in the proportion in corporate employment. In contrast, several disciplines diversified out of corporate employment into engineering and architectural services and government. More mechanical and petroleum engineers moved into consulting services while electrical and nuclear engineers increased their representation in government employment. (Table 4.7)

## **Registration**

The number of registered engineers for 2000/2001 was obtained from California and all but two of the comparison states (Pennsylvania and Florida). Using OES survey estimates of the number of employed engineers in these states, a registration rate was computed for nine of the eleven states. (See Table 4.8.) With the exception of Rhode Island, where 60% of engineers work for a government agency and the registration rate is 9.5%, registration rates vary between 43.5% (Texas) and 68.4% (New Jersey). Three states (New Jersey, North Carolina, and Ohio) are grouped at the high end of this range, with registration rates between 64.4% and 68.4%. The remaining states are also grouped, but at the lower end of the range, between 43.5% (Texas) and 48.9% (Illinois). (Table 4.8)

Registration rates can also be computed by comparing the number of registered engineers to a state's population and to the dollar value of heavy construction in a state. Each of these rates provides a different way of looking at the supply of licensed engineers. Using population as the base is a useful standard for comparing states and disciplines, but population alone is not necessarily related to engineering activities. The amount of heavy construction is an appropriate base for engineering disciplines closely allied with construction, but it is less useful in considering the number in disciplines unrelated to construction. (Table 4.9)

The number of registered engineers per 100,000 population varies from a low of 37 in Rhode Island to a high of 292 in Massachusetts. The average for discipline-based licensing states is 193 compared with 210 in generic states. If Rhode Island is removed from this average because of its unusually small number of registered engineers and the unusually high proportion of engineers employed by government in this state, the average registration rate for the two remaining discipline-based licensing states jumps to 272 -- almost 30% higher than the number of registered engineers per 100,000 population in the generic licensing states. Apparently, discipline-based licensing encourages the licensing of engineers. (Table 4.9)

Registration rates are more closely related to the dollar amount of heavy construction. The average for discipline-based licensing states is 4.43 compared with 5.03 in generic licensing states. Once Rhode Island is removed because of its unusually small number of registered engineers, then the registration rate of 5.98 per million in heavy construction for the discipline-based licensing states is 19% higher than the rate of 5.03 in the generic licensing states. With the exception of Rhode Island, the states vary between a low of 4.1 registered engineers per million dollars of heavy construction and a high of 7.0. California, Ohio and New Jersey have approximately 6 registered engineers while Massachusetts, New York, North Carolina, Texas and Illinois have approximately 4 per million spent on heavy construction. (Table 4.9)

**Registration by discipline.** Registration by discipline was available for two of the three discipline-based licensing states -- California and Rhode Island. Due to the dominance of government employment among Rhode Island's engineers, registration rates in that state are

not good comparisons for California. For purposes of this report, however, discipline variations *within* California are instructive. (Table 4.10)

When the number of 2000/2001 registered engineers in California is compared with OES survey estimates for 2000, the percent registered varies widely by discipline. (Table 4.10) Some of the smaller disciplines (agricultural and chemical engineering) have more registered than OES counted in its survey. This could be due to engineers continuing their registration even though they are no longer employed as engineers or it could be a result of sampling error and the selection of firms and industries. Finally, licensees with multiple licenses would contribute to the disparity between employment and registration. Civil, one of the larger disciplines, also has more registrants than OES counted in the employed population -- 50% more. The disparity may be due to employers identifying engineers by their position or occupational classification rather than the discipline in which they are registered. Thus, registered civil engineers may be employed in positions identified as environmental or aeronautical/aerospace. In addition, OES may not sample a sufficient number of engineering and architectural services firms in California. Since nationally, roughly half of all civil engineers are employed in consulting firms and California has the second smallest percentage so employed in the seven states with available OES survey data, this may account for their under-representation. (Tables 4.7 and 4.6)

Agricultural, chemical and civil engineering are the three disciplines where the number registered is greater than the number estimated to be employed in the state (2.33, 1.54 and 1.04 respectively registered for every one employed). Nuclear and mechanical engineers have the next highest registration rates, with 88% and 60% respectively. Roughly half of all petroleum engineers in California are registered. Rates are lowest for materials (18%), electrical (13%) and industrial (4%). (Table 4.10)

When registration rates per 100,000 population are computed for California and Rhode Island, registered civil engineers outnumber all other disciplines combined (129 vs. 112 per 100,000 population). Registered civil engineers per 100,000 population outnumber electrical engineers 5:1 and mechanical engineers 3:1. The next largest groups are structural, control systems and chemical with 9, 7 and 6 registered per 100,000. (Table 4.11)

**Registration among California's title act disciplines.** In addition to civil, the oldest engineering disciplines in California are the two other practice acts (mechanical and electrical) and chemical and petroleum, the first title acts, licensed in 1947. In the mid-1960s, industrial and metallurgical were added to the list of title act disciplines and mechanical and electrical, initially defined with title protection only, were given practice protection. In the mid-1970s, six additional disciplines (agricultural, control systems, fire protection, manufacturing, nuclear and traffic) were given title protection. Those active in these areas at the time were not required to take exams, but were grandfathered into licensing. One indicator of the continuing viability of these disciplines is the proportion of those currently licensed that became registered since 1980. The ten disciplines fall into three distinct groups in terms of licensing activity during the past twenty years. Roughly half to two-thirds of currently licensed chemical, fire protection, traffic and petroleum engineers have been licensed since 1980, proportions comparable to two of the practice disciplines (civil and electrical with 67% and 65% respectively). Three-fourths of mechanical engineers have been licensed since 1980. Between a fourth and a third of currently registered agricultural, nuclear and metallurgical engineers were licensed during the same period. There has been relatively little licensing activity during this period in control systems, industrial and manufacturing (between 3% and 19%). (Table 4.12 and 4.13)

Table 4.1. Distribution of Employed Engineers by Discipline for California and Ten Comparison States, 2000

Discipline <sup>1,2</sup>	Discipline-Based Licensing			Generic Licensing								National
	CA %	MA %	RI %	FL %	IL %	NC %	NJ %	NY %	OH %	PA %	TX %	
Aerospace	12.1	0.0	0.0	6.3	0.0	0.6	0.9	1.6	3.0	0.0	7.0	6.0
Agricultural	0.1	0.0	0.0	0.4	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.2
Biomedical	0.5	1.8	0.0	0.9	0.9	0.4	0.0	0.0	0.3	0.8	0.4	0.6
Chemical	1.1	2.8	1.7	1.1	4.8	4.2	6.2	2.3	2.8	5.8	3.0	2.6
Civil	16.1	12.2	10.7	27.1	20.1	15.1	22.9	21.9	11.2	16.6	13.9	17.3
Electrical	36.3	37.2	41.2	31.4	24.0	32.8	34.4	33.6	21.9	24.9	32.0	29.2
Environmental	2.8	6.3	6.1	4.9	2.8	5.1	7.7	8.5	4.7	4.7	2.9	4.0
Health and Safety	2.7	3.0	2.4	4.1	2.1	3.0	2.2	0.0	2.4	4.3	2.7	3.6
Industrial	11.5	15.6	14.4	9.1	15.9	18.6	7.9	14.2	26.6	15.7	11.5	14.3
Marine	0.1	0.1	0.0	1.1	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.4
Materials	1.3	3.3	3.2	1.6	2.3	2.6	1.4	1.8	3.4	3.3	1.5	2.0
Mechanical	13.8	17.3	20.2	11.6	25.7	16.6	16.0	15.3	23.1	19.7	19.0	17.3
Mining	0.5	0.0	0.0	0.4	0.4	0.2	0.0	0.1	0.4	0.7	1.4	0.6
Nuclear	0.6	0.3	0.0	0.0	0.5	0.8	0.1	0.0	0.0	3.5	0.1	1.1
Petroleum	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.2	0.1	0.0	4.3	0.9
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total # of Engineers	176,860	40,900	4,100	46,290	44,160	25,290	27,820	58,730	48,720	44,250	111,320	1,197,540

<sup>1</sup>Employment data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

Table 4.2. Distribution of Employed Engineers by Discipline for Discipline-Based and Generic Licensing States, 2000

Discipline <sup>1,2</sup>	Discipline <sup>3</sup> %	Generic <sup>3</sup> %	National %
Aerospace	9.7	3.3	6.0
Agricultural	0.1	0.1	0.2
Biomedical	0.7	0.5	0.6
Chemical	1.5	3.4	2.6
Civil	15.3	17.9	17.3
Electrical	36.6	29.5	29.2
Environmental	3.5	4.8	4.0
Health and Safety	2.8	2.5	3.6
Industrial	12.3	14.6	14.3
Marine	0.1	0.2	0.4
Materials	1.7	2.1	2.0
Mechanical	14.5	18.6	17.3
Mining	0.4	0.6	0.6
Nuclear	0.6	0.5	1.1
Petroleum	0.4	1.3	0.9
	100.0	100.0	100.0
Total # of Engineers	221,860	406,580	1,197,540

<sup>1</sup>Employment data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

<sup>3</sup>Proportions are weighted by the total number of engineers in each group of states.

Table 4.3. Distribution of Employed Engineers by Discipline<sup>1,2</sup>, 1988-90 and 2000

1988-1990	%	2000	%
Aeronautical	6.9	Aerospace	6.0
Agricultural	0.3	Agricultural	0.2
Chemical	4.7	Chemical	2.6
Civil, incl. traffic	14.5	Civil	17.3
Electrical	35.0	Electrical	29.2
Industrial	11.6	Industrial	14.3
Marine	0.4	Marine	0.4
Mechanical	20.8	Mechanical	17.3
Metallurgical	1.8	Materials	2.0
Mining	0.3	Mining	0.6
Nuclear	1.0	Nuclear	1.1
Petroleum	1.1	Petroleum	0.9
Safety	1.7	Health and Safety	3.6
All Other	22.2	Biomedical	0.6
		Environmental	4.0
	100.0		100.0
Total # Engineers	1,125,020		1,197,540

<sup>1</sup>1988-1990 employment data from 1988-1990 National Occupation Employment Statistics. 2000 data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

Table 4.4. Number of Employed Engineers per 100,000 Population<sup>3</sup> by Discipline for California and Ten Comparison States, 2000

Discipline <sup>1,2</sup>	Discipline-Based Licensing			Generic Licensing								National
	CA	MA	RI	FL	IL	NC	NJ	NY	OH	PA	TX	
Aerospace	63	0	0	18	0	2	3	5	13	0	37	25
Agricultural	0	0	0	1	0	0	0	0	0	0	1	1
Biomedical	3	12	0	3	3	1	0	0	1	3	2	2
Chemical	6	18	7	3	17	13	21	7	12	21	16	11
Civil	84	78	42	78	72	47	76	68	48	60	74	74
Electrical	190	240	161	91	85	103	114	104	94	90	171	124
Environmental	14	41	24	14	10	16	26	26	20	17	16	17
Health and Safety	14	19	10	12	8	9	7	0	10	15	14	26
Industrial	60	101	56	26	56	59	26	44	114	56	61	61
Marine	0	1	0	3	0	0	0	1	0	0	0	0
Materials	7	21	12	5	8	8	5	6	15	12	8	9
Mechanical	72	111	79	34	92	52	53	47	99	71	102	74
Mining	2	0	0	1	1	0	0	0	2	3	8	2
Nuclear	3	2	0	0	2	2	0	0	0	13	1	4
Petroleum	3	0	0	0	1	0	0	1	0	0	23	4
Overall	522	644	391	290	356	314	331	309	429	360	534	435

<sup>1</sup>Employment data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

<sup>3</sup>Population data from 2000 Census.



Table 4.5. Average Rate of Employed Engineers per 100,000 Population by Discipline for Discipline-Based and Generic Licensing States, 2000

Discipline <sup>1,2</sup>	Discipline-Based Licensing	Generic Licensing	National
Aerospace	21	10	25
Agricultural	0	0	1
Biomedical	5	2	2
Chemical	10	14	11
Civil	68	65	74
Electrical	197	106	124
Environmental	26	18	17
Health and Safety	14	10	26
Industrial	72	55	61
Marine	0	1	0
Materials	13	8	9
Mechanical	87	69	74
Mining	1	2	2
Nuclear	2	2	4
Petroleum	1	3	4
Total	519	365	435

<sup>1</sup>Employment data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

Table 4.6. Distribution of Employed Engineers<sup>1,3,4</sup> by Industry for California and Six Comparison States, 1998

		Engineering & Architecture Services <sup>2</sup>	Government	Industrial Corporation
		%	%	%
Discipline-Based Licensing	California	12.1	15.7	72.1
	Massachusetts	25.1	3.0	71.9
	Rhode Island	8.6	59.5	31.9
Generic Licensing	Florida	15.2	14.4	70.5
	North Carolina	13.0	3.3	83.7
	Pennsylvania	29.0	13.7	57.3
	Texas	17.7	2.9	79.4

<sup>1</sup>Employment data from 1998 State Occupation Employment Statistics except Texas. The three years of 1996, 1997, and 1998 have been combined to produce the 1998 results. Texas employment data from 2001 State OES. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>SIC 871 Engineering & Architecture Services not available for Texas and Massachusetts. Estimates from SIC 87 Engineering & Management Services used instead

<sup>3</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

<sup>4</sup>This table excludes the following OES engineering occupations: Aeronautical, Mining, Marine, and Safety.

Table 4.7. National Distribution of Employed Engineers by Industry, Discipline and Year, 1988-90 and 2000

Discipline <sup>1,2,3</sup>	1988-1990	1988-1990	1988-1990	2000	2000	2000
	E&A Services	Government	Industrial Corporation	E&A Services	Government	Industrial Corporation
	%	%	%	%	%	%
Agricultural	45.23	--	54.77	22.10	20.99	56.91
Chemical	10.90	--	89.10	9.73	5.26	85.00
Civil	37.97	39.56	22.47	50.57	29.43	20.00
Electrical and Electronic	7.50	1.45	91.05	13.16	9.24	77.60
Industrial	4.10	--	95.90	3.38	0.98	95.64
Metallurgical	13.79	--	86.21	3.56	6.34	90.11
Mechanical	4.07	--	95.93	15.51	4.99	79.50
Nuclear	23.16	--	76.84	12.22	15.76	72.03
Petroleum	--	--	100.00	13.41	4.67	81.92
All Other	5.23	5.56	89.21	--	--	--
Overall	12.03	6.64	81.33	19.73	11.17	69.10

<sup>1</sup>1988-1990 employment data from 1988-1990 National Occupation Employment Statistics. 2000 employment data from 2000 National OES. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

<sup>3</sup>This table excludes the following OES engineering occupations: Aeronautical, Marine, Mining, and Safety. This table excludes the following SOC engineering occupations: Aerospace, Biomedical, Environmental, Health and Safety, Mining, and Marine.

Table 4.8. Registration Rate Among Employed Engineers for California and Eight Comparison States, 2000

		OES Estimate 2000 <sup>1,2</sup>	Registered 00/01 <sup>3</sup>	Proportion of Employed Engineers Registered
Discipline-Based Licensing	California	176,860	85,083	0.481
	Massachusetts	40,900	18,521	0.453
	Rhode Island	4,100	390	0.095
Generic Licensing	Illinois	44,160	21,611	0.489
	New Jersey	27,820	19,017	0.684
	New York	58,730	26,376	0.449
	North Carolina	25,290	16,876	0.667
	Ohio	48,720	31,376	0.644
	Texas	111,320	48,434	0.435

<sup>1</sup>Employment data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

<sup>3</sup>Registration data from State licensing boards.

Table 4.9. Number of Registered Engineers per 100,000 Population and per \$1,000,000 in Heavy Construction for California and Six Comparison States, 2000/2001<sup>1</sup>

		Registration Rate per 100,000 population	Registration Rate per \$1,000,000 in Heavy Construction
Discipline-Based Licensing	California	251	6.98
	Massachusetts	292	4.98
	Rhode Island	37	1.33
	Average of 3 states	193	4.43
	Average w/out RI	272	5.98
Generic Licensing	Illinois	174	4.07
	New Jersey	226	6.05
	New York	139	4.99
	North Carolina	210	4.45
	Ohio	276	6.52
	Texas	232	4.10
	Average	210	5.03

<sup>1</sup>Registration data provided by State boards. Population from US Census 2000. Heavy Construction from Economic Census 1997.

Table 4.10. Registration Rate Among Employed Engineers by Discipline for California and Rhode Island, 2000/2001

Discipline <sup>1,2,3</sup>	California			Rhode Island		
	OES Estimate 2000	Registered 00/01 <sup>4</sup>	Proportion of Employed Engineers Registered	OES Estimate 2000	Registered 00/01 <sup>4</sup>	Proportion of Employed Engineers Registered
Agricultural	120	280	2.33	0	-	-
Chemical	2,030	2,121	1.04	70	7	0.10
Civil	28,450	43,710	1.54	440	197	0.45
Electrical	64,280	8,312	0.13	1,690	64	0.04
Environmental	4,890	-	-	250	4	0.02
Industrial	20,360	845	0.04	590	-	-
Materials	2,270	418	0.18	130	-	-
Mechanical	24,330	14,646	0.60	830	77	0.09
Nuclear	1,110	980	0.88	0	-	-
Petroleum	940	476	0.51	0	-	-
Total	148,780	71,788	0.48	4,000	349	0.00

<sup>1</sup>Employment data from 2000 Occupation Employment Statistics. The OES survey is a Federal-State cooperative program between the Bureau of Labor Statistics (BLS) and State Employment Security Agencies (SESAs). In 1999 the OES survey switched from the OES occupational classification system to the new Office of Management and Budget (OMB) Standard Occupational Classification (SOC) system, which will be used by all Federal statistical agencies for reporting occupational data. 2000 OES uses SOC system. Most engineering occupations are the same in the old OES classification system and the new SOC system. The old category of "All other engineers" is no longer published and Biomedical and Environmental Engineers have been added. Two categories in the old system, Computer engineering and Electrical and Electronic engineering, overlapped by each counting Computer Hardware engineers within their area. In the new system, two categories have become five with Computer Software, Applications and Computer Software, Systems distinguished within the former category of Computer engineering and Electrical and Electronic distinguished within their area. Computer Hardware became the fifth category, separated from both. For all tables using 2000 data, Electrical, Electronic, and Computer Hardware have been combined into one category. For all tables using 1988-1998 data, the category of Computer Engineer has been excluded.

<sup>2</sup>Disciplines registered in California but not included in OES are Fire Protection, Control Systems, Manufacturing, Geotechnical and Structural.

<sup>3</sup>This table excludes the following SOC engineering occupations: Aerospace, Biomedical, Health and Safety, Mining, and Marine.

<sup>4</sup>Registration data from State licensing boards.

Table 4.11. Number of Registered Engineers per 100,000 Population by Discipline for California and Rhode Island, 2000/2001<sup>1</sup>

Discipline	California	Rhode Island
Civil	129	19
Geotechnical	3	-
Structural	9	5
Electrical	25	6
Mechanical	43	7
Agricultural	1	-
Chemical	6	1
Control Systems	7	-
Fire Protection	3	-
Industrial	2	-
Manufacturing	4	-
Metallurgical	1	-
Nuclear	3	-
Petroleum	1	-
Traffic	4	-
Environmental	-	0

<sup>1</sup>Registration data provided by State boards. Population from US Census 2000.

Table 4.12. Year License Issued by Discipline, for Engineers with Current California Licenses as of 2002

Year license issued	Practice Act Disciplines			Title Act Disciplines										Total
	Civil	Elec- trical	Mechan- ical	Agri- cultural	Chem- ical	Control Systems	Fire Pro-tection	Industrial	Manu- facturing	Metal- lurgical	Nuclear	Petroleum	Traffic	
1937	1													1
1938	1													1
1939	3													3
1940	6													6
1941	5													5
1942	6													6
1943	9													9
1944	8													8
1945	10													10
1946	21													21
1947	28	1												29
1948	48	163	71		24							21		327
1949	59	73	218		41							10		401
1950	37	10	17		4									68
1951	60	8	8		2							3		81
1952	67	8	17		3							1		96
1953	120	14	25		4									163
1954	156	17	12		1							1		187
1955	274	34	47		5							4		364
1956	166	32	39		8							3		248
1957	214	38	76		2							4		334
1958	157	22	35		9							2		225
1959	353	50	53		10							11		477
1960	157	22	41		7							6		233
1961	256	52	107		8							7		430
1962	210	40	49		2							1		302
1963	442	52	49		11							6		560
1964	335	62	59		7							4		467
1965	608	94	26		15							4		747
1966	467	47	80		8					142		1		745
1967	519	80	65		14			2		53		2		735
1968	384	62	68		14			152		27		6		713
1969	717	103	11		13			289		9		2		1,144
1970	392	67	83		8			113		3		3		669
1971	860	136	83		15			40		7		3		1,144
1972	586	102	137		17			21		1		2		866
1973	968	175	108		21			5		15		7		1,299
1974	575	116	198		13			3		1		4		910
1975	1,128	254	163	16	56	79	29	13	25	10	29	13	46	1,861
1976	1,125	171	38	96	32	266	110	6	132	9	24	3	185	2,197
1977	999	289	461	68	63	471	237	14	167	8	477	5	313	3,572
1978	1,047	328	494	6	111	1,119	37	11	832	12	46	8	58	4,109
1979	985	221	540	5	69	103	24	12	149	3	11	8	49	2,179
1980	1,080	213	425	5	60	18	16	5	4	3	10	13	19	1,871
1981	1,205	262	471	4	38	14	6	10	1	8	8	10	22	2,059
1982	1,565	269	499	5	109	19	12	10	4	11	4	15	14	2,536
1983	1,464	260	606	10	112	16	10	12		9	11	16	16	2,542
1984	1,292	271	589	2	103	22	9	12	3	7	12	29	25	2,376
1985	819	200	479	2	29	15	6	10	3	8	11	43	13	1,638
1986	1,114	173	1,139	6	22	12	24	3	1	10	6	24	27	2,561
1987	1,972	244	1,137	4	15	7	9	8	1	7	193	27	36	3,660
1988	190	206	444	1	36	11	19	7	1	5	4	19	30	973
1989	1,254	305	622	2	53	3	21	12	1	6		15	24	2,318
1990	1,312	256	494	3	79	4	11	11	1	8		6	26	2,211
1991	2,075	188	541	7	61	16	16	7	1	6	3	14	40	2,975
1992	1,234	233	368	1	137	13	17	12	2	1	6	16	40	2,080
1993	1,236	264	509	3	70	6	22	8	1	1	5	17	111	2,253
1994	1,679	288	422		53	14	16	6		5	3	13	3	2,502
1995	1,784	381	411	2	88	13	31	4	5	1	4	3	44	2,771
1996	1,494	225	443	2	63	16	22	7	1	5		1	26	2,305
1997	1,361	334	333	2	68	9	20	5	1	4	3	4	55	2,199
1998	913	223	399	2	30	16	17	3	1	3	1	13	35	1,656
1999	1,155	206	331		52	13	25	3		5	2	8	53	1,853
2000	1,221	207	339	1	40	15	25	3	1	5	1	3	37	1,898
2001	1,402	222	309	1	38	9	10	2	1	5	3	7	53	2,062
2002	745	71	90	1	39	5	6	4	1			2	1	965
Total	44,135	8,444	14,878	257	2,012	2,324	807	845	1,340	423	877	473	1,401	78,216

Table 4.13. Percent of Currently Licensed California Engineers with Licenses Issued Before and After 1980

	Year license issued	Practice Act Disciplines			Title Act Disciplines										Total
		Civil	Electrical	Mechanical	Agricultural	Chemical	Control Systems	Fire Protection	Industrial	Manufacturing	Metal-lurgical	Nuclear	Petroleum	Traffic	
Percent	Before 1980	33%	35%	23%	74%	31%	88%	54%	81%	97%	71%	67%	33%	46%	36%
	1980 or later	67%	65%	77%	26%	69%	12%	46%	19%	3%	29%	33%	67%	54%	64%
	Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Number	Before 1980	14,569	2,943	3,478	191	617	2,038	437	681	1,305	300	587	155	651	27,952
	1980 or later	29,566	5,501	11,400	66	1,395	286	370	164	35	123	290	318	750	50,264
	Total	44,135	8,444	14,878	257	2,012	2,324	807	845	1,340	423	877	473	1,401	78,216